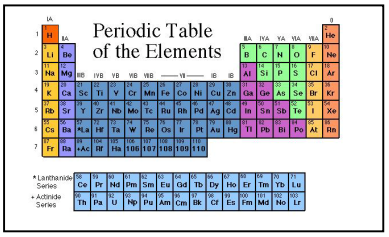
Activity # 11



Title: Graphing Trends in the Periodic Table-Teacher's Copy

Note to the teacher: Although this particular lesson plan utilizes the graphing calculator to plot various data, Microsoft Excel (or other similar computer graphing programs) can also be employed in this activity successfully.

Prerequisites: Students should be familiar with atomic structure, Bohr model diagrams of atoms, a basic introduction to the periodic table and familiarity with the use of graphing calculators (if this is the selected mode for graphical display of data).

National Standards addressed:

Physical Science

CONTENT STANDARD B: As a result of their activities in grades 9-12, all students should develop an understanding of

- **Structure of atoms**
- **Structure and properties of matter**

GUIDE TO THE CONTENT STANDARD

Fundamental concepts and principles that underlie this standard include

STRUCTURE OF ATOMS

STRUCTURE AND PROPERTIES OF MATTER

- An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies.
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Science as Inquiry

CONTENT STANDARD A: As a result of activities in grades 9-12, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

DEVELOPING STUDENT ABILITIES AND UNDERSTANDING

Students need to learn how to analyze evidence and data. The evidence they analyze may be from their investigations, other students' investigations, or databases. Data manipulation and analysis strategies need to be modeled by teachers of science and practiced by students. Determining the range of the data, the mean and mode values of the data, plotting the data, developing mathematical functions from the data, and looking for anomalous data are all examples of analyses students can perform. Teachers of science can ask questions, such as "What explanation did you expect to develop from the data?" "Were

there any surprises in the data?" "How confident do you feel about the accuracy of the data?" Students should answer questions such as these during full and partial inquiries.

Purpose: To graphically display various properties of selected elements on the periodic table as related to their atomic numbers to determine if periodicity exists

Materials: graphing calculator (Texas Instruments model TI-82 is used in this lesson.)

GRAPHING TRENDS IN THE PERIODIC TABLE

IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA
3	4	5	6	7	8	9	10
Li	Be	B	C	N	O	F	Ne
1.23	0.89	0.80	0.77	0.70	0.66	0.64	0.67
124	215	191	260	335	314	402	497
11	12	13	14	15	16	17	18
Na	Mg	Al	Si	P	S	Cl	Ar
1.57	1.36	1.25	1.17	1.10	1.04	0.99	0.98
119	176	138	188	242	239	299	363
19	20						
K	Ca						
2.03	1.74						
100	141						
37	38						
Rb	Sr						
2.16	1.91						
96	131						
55	56						
Cs	Ba						
2.35	1.98						
90	120						

LEGEND

8--------atomic number
O--------symbol
0.66-----atomic radius
314------energy to remove easiest electron

Procedure:

1. Make a **prediction** as to what will happen to the sizes of atoms as one progresses from left to right across a period on the periodic table. (Example: the sizes of atoms will (increase, decrease, remain constant) as one goes left to right across a period.) Most students realize that additional protons, neutrons and electrons are added to atoms as one progresses left-to-right across a period. Consequently, they make an incorrect prediction here by stating that the atom size (atomic radius) increases. Once they learn otherwise, the student is then far more cautious when making subsequent predictions.
2. According to your prediction, make a **sketch** of how you would EXPECT a graph to appear if you plotted atomic number on the X-axis and atomic radius (size of the atom) on the Y-axis. (5 cm X 5 cm size is appropriate.)
3. Using the information supplied in the chart above, enter the atomic numbers of elements 3-20 in L1 and the corresponding atomic radius in L2 in your **graphing calculator**. Create a connected-dot line graph and display it on your calculator screen. Check for accuracy (with your beloved teacher!) before proceeding. If your graph is acceptable, **sketch** it on your answer sheet. Specific instructions are included in this lesson that detail the steps necessary to plot this information on the TI-82 graphing calculator. Other brands/models of graphing calculators, Microsoft Excel or even hand-drawn pencil-and-paper graphs can be also be used successfully.

4. Record any **similarities and differences** between your predicted graph and the graph of actual data.
5. **What does happen** to the sizes of atoms as one goes left to right across a period?
6. Looking at the Bohr models of atoms in a period, offer an **explanation as to WHY** the atomic size changes as it does.

7-12. Repeat steps 1-6 above, except this time refer to **the change in the size of atoms going down a group**. Use elements #3, 11, 19, 37, & 55 for one graph and #4, 12, 20, 38, & 56 for another.

13-18. Repeat steps 1-6 above, except this time refer **the energy required to remove the easiest electron as one goes across a period.** Use elements #3-20.

19-24. Repeat steps 1-6 above, except this time refer to **the energy required to remove the easiest electron as one goes down a group**. Use elements #3, 11, 19, 37, & 55 for one graph and #4, 12, 20, 38, & 56 for another.

25. How many ACTUAL graphs created in this activity demonstrated some form of repeating pattern? Those that do would be demonstrating "periodicity" or properties that reoccur periodically---over and over again.
26. What PROPERTIES of elements visibly show periodic trends when their values are graphed?